

Electronic supplementary information

Title: Correlative near-infrared light and cathodoluminescence microscopy using  $\text{Y}_2\text{O}_3\text{:Ln}$ , Yb (Ln = Tm, Er) nano-phosphors for multiscale, multicolour bioimaging

Authors

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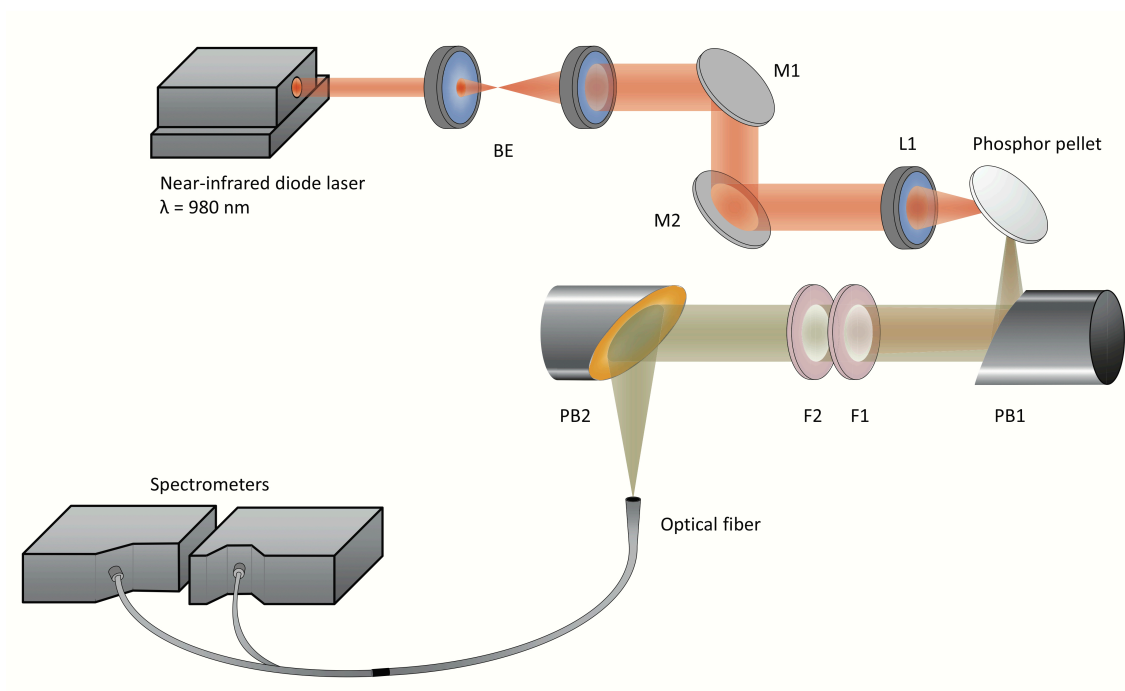


Fig. S1: Optical setup for the acquisition of luminescence from  $\text{Y}_2\text{O}_3$  phosphor pellets. Setup included a near-infrared diode laser (IRM980TR-500, Laser Century); a pair of achromatic lenses (AC-254-075-C, Thorlabs) as a beam expander, BE; and silver-coated mirrors M1 and M2. Near-infrared laser light was focused onto phosphor pellet by an achromatic lens (AC-254-075-C, Thorlabs; L1) and filtered by a short-pass filter (BlightLine, fluorescence filter 950/SP, Semrock; F1) and a long-pass filter (RazorEdge LongPass 980, Semrock; F2). Luminescence from the phosphor pellet was collected by silver-coated parabolic mirror (MPD254254-90-P01, Thorlabs; PB1, PB2) and was led to a spectrometer (USB4F10023, Oceanoptics, NIRQUEST, NQ51A0577, Oceanoptics) through a two-branched optical fibre (CUSTOM-BIF-6174546, 1000  $\mu\text{m}$  VIS/NIR, Oceanoptics). The obtained spectral intensity was calibrated by using a light source device (HL2000, Oceanoptics).

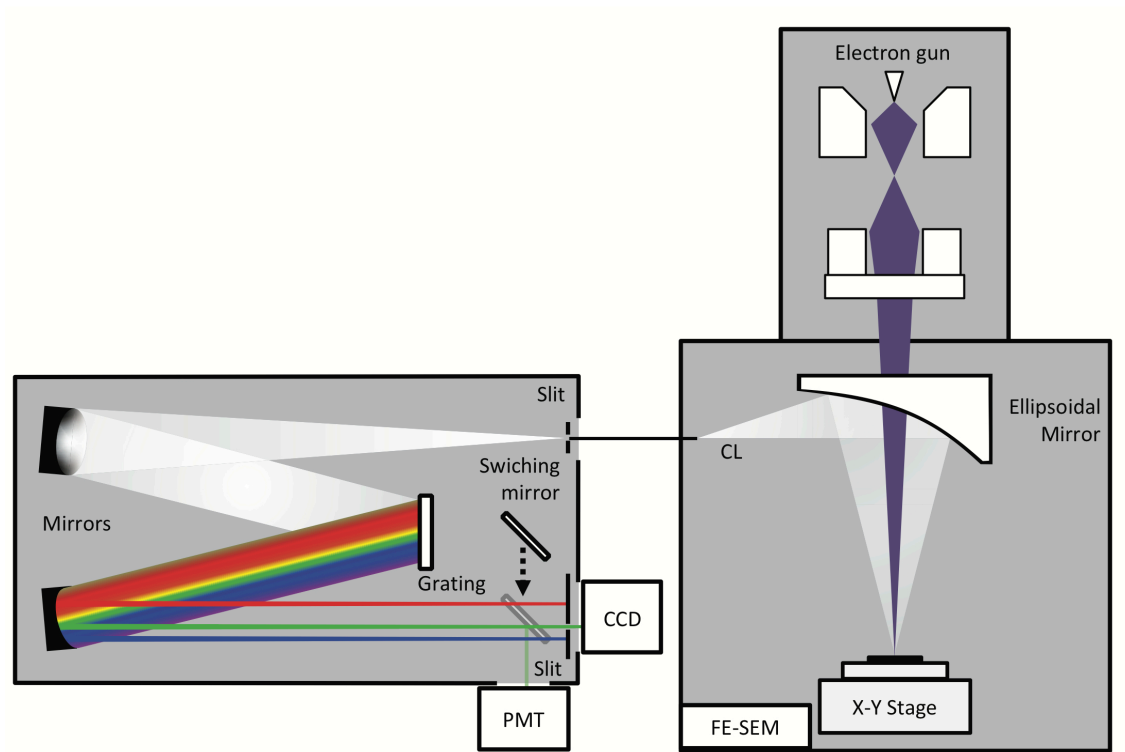


Fig. S2: Experimental setup for SEM-CL imaging. Accelerated electrons excite specimens, and secondary electrons and CL are emitted. Ellipsoidal mirror leads CL to spectrometer (TRIAX-320, Horiba-Jobin Yvon) through a quartz optical fibre. CL spectrum is obtained by a cooled CCD camera (CCD-1024×256-4, Horiba-Jobin Yvon). CL image is constructed with photomultiplier tube (R943-02, Hamamatsu).

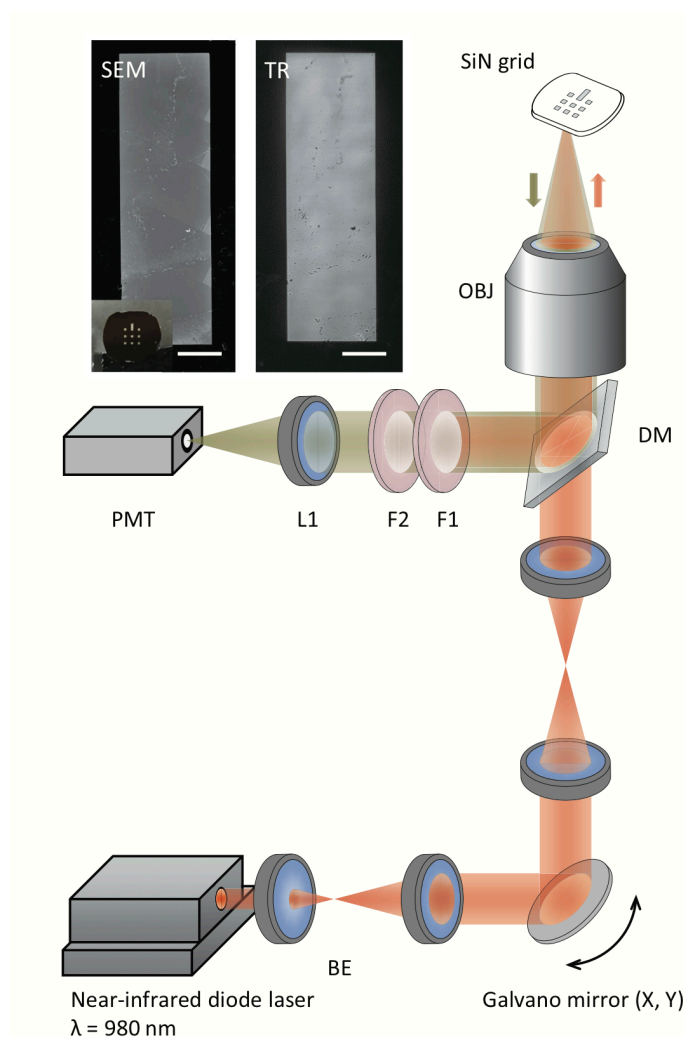


Fig. S3: Optical setup for NIR imaging, including a near-infrared diode laser (MDL-III-980/1~2000mW, CNI) and a pair of achromatic lenses (AC-254-075-C, Thorlabs) as a beam expander, BE. This setup was constructed with commercial laser scanning microscope (C1, Nikon).

For acquisition of near-infrared luminescence from  $\text{Y}_2\text{O}_3\text{:Tm}$ ,  $\text{Yb}$  NPs, an objective lens (LCPlan N 20x, NA 0.45, Olympus), OBJ; a dichroic long-pass filter (FF87501-25x36, Semrock), DM; a short-pass filter (FF01-950/SP-25, Semrock), F1; a band-pass filter (Hard Coated Bandpass Filter 800 nm 25 mm, OD4, Edmund Optics), F2; and a photomultiplier tube (Hamamatsu, H7844, Hamamatsu), PMT, were used. Visible luminescence from  $\text{Y}_2\text{O}_3\text{:Tm}$ ,  $\text{Yb}$  NPs was acquired with the same optical setup except for the objective lens (LR Plan NIR 20x, NA 0.4) and the band-pass filter (FF01-510/84/25, Semrock).

For acquisition of NIRL from  $\text{Y}_2\text{O}_3\text{:Er}$ ,  $\text{Yb}$  NPs, an objective lens (M Plan Apo NIR 20x, NA 0.4, Mitutoyo), OBJ; a dichroic short-pass filter (TS dichroic short-pass 1200 nm, Edmund Optics), DM; a long-pass filter (High Performance Longpass Filter 1100 nm 25 mm, OD4, Edmund Optics), F1; a band-pass filter (Hard Coated Bandpass Filter 1550 nm 25 mm, OD4, Edmund Optics), F2; and a near-infrared photomultiplier tube (H10330B-75, Hamamatsu), PMT, were used. Insets: SEM and transmission (TR) images of SiN membrane grid. Scale bar: 50  $\mu\text{m}$ .

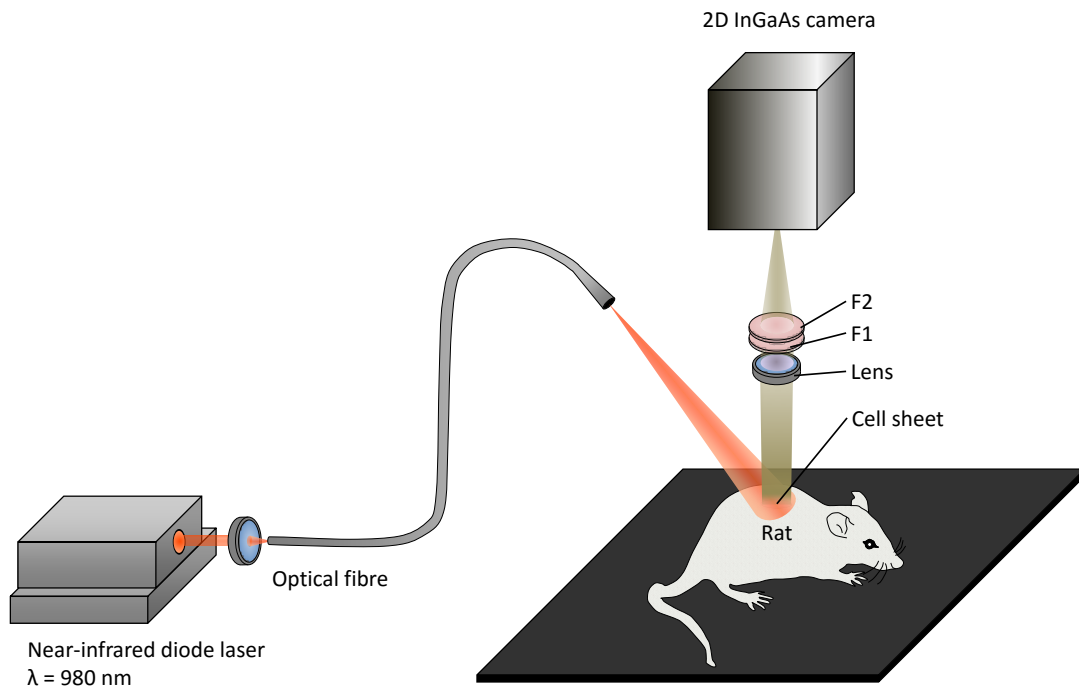


Fig. S4: Optical setup for the *in vivo* NIRL deep tissue observation of cell sheet transplanted in the back of a hairy mouse and *in vitro* cell sheet imaging with tissue phantom (2% intralipid). An inbred mouse was illuminated by 980 nm near-infrared laser light under anesthesia. Setup included a near-infrared diode laser (IRM980TR-500, Laser Century); optical fibre (CUSTOM-BIF-6174546, 1000  $\mu\text{m}$  VIS/NIR, Oceanoptics), Lens (VF50095M, SPACECOM, 50 mm, F 0.95), a long-pass filter (High Performance Longpass Filter 1100 nm 25 mm, OD4, Edmund Optics), F1; a band-pass filter (Hard Coated Bandpass Filter 1550 nm 25 mm, OD4, Edmund Optics), F2; and a 2D InGaAs CCD (NIRvana:640, Princeton Instruments).